

four patent applications are based on nine "inventive concepts," each of which could be an independent patent if the intent were to maximize the number of patents, as is often done in start-up companies. The writing of the patent applications was still in progress at the end of FY00. After approval by Ames and NASA Headquarters, completed applications are submitted to the United States Patent Office. Meanwhile, the CTO is developing a commercial licensing strategy for the new technologies.

The new methods have been documented in the paper, "Searching the ASRS database using QUORUM Keyword Search, Phrase Search, Phrase Generation, and Phrase Discovery." The paper has been approved for publication pending submission of the patent applications.

Point of Contact: Michael W. McGreevy  
(650) 604-5784  
mmcgreevy@mail.arc.nasa.gov

## Alternative Perspectives on Traffic Risk

Jeannie Davison, Judith Orasanu

A study was conducted to identify differences in the ways airline pilots and air traffic controllers might perceive risks and resolve problems in simulated traffic and control environments. Pilots and controllers are faced routinely with situations requiring them to make decisions that affect flight safety. Critical elements in decision making include recognizing cues that indicate some change in the circumstances and assessing the situation to ensure that effective decisions are made and appropriately implemented. Pilots and air traffic controllers perceive and respond differently to risks associated with operations in the National Airspace System (NAS). These differences contribute to miscommunications and increased aviation risks.

We examined whether air traffic controllers and airline pilots differ in their perceptions of risk (or threat) associated with varying traffic configurations and different air traffic control (ATC) environments (existing rules vs. free flight). The concept of free flight involves development of a more flexible ATC system, allowing user-preferred routing and flight crew self-separation in the en route portion of flight. A second goal of the study was to examine

whether the two groups would respond differently (that is, choose different maneuvering options) as a function of role, ATC environment, and varying traffic conditions.

Scenarios of evolving en route traffic situations were presented on a desktop computer to 32 airline pilots and 32 air traffic controllers. Participants indicated the amount of risk they perceived in individual snapshots displayed sequentially to represent evolving traffic scenarios. A sample of the display used in the study is shown in figure 1. In addition, participants indicated their preferred response to each situation by selecting maneuvering options.

Analyses revealed that risk perception was affected more by features of individual traffic situations than by either the participant's role (pilot or air traffic controller) or the operative ATC environment (existing rules or free flight). The proximity of conflicting traffic had the greatest effect on the controllers' ratings of risk, with the nearest proximity traffic scenarios being rated as significantly higher in risk than the far-proximity scenarios. For pilots, uncertainty appeared to be the primary factor in risk ratings. Pilots assigned the

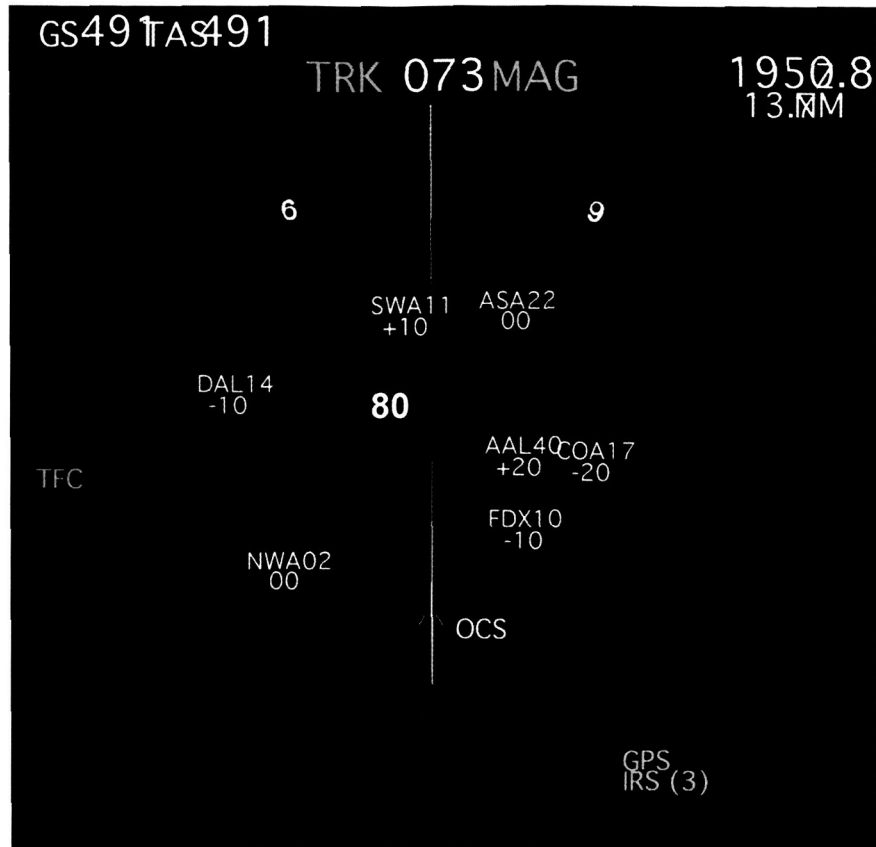


Fig. 1. Example of a display showing an evolving traffic scenario.

highest risk ratings to the scenarios in which they had most difficulty making accurate judgments concerning where their flightpath would cross that of another aircraft. In addition, controllers assigned their highest risk ratings to scenarios with high-density/descending traffic, whereas pilots assigned their lowest risk ratings to these same scenarios. These risk ratings correspond to the maneuvers that participants indicated they would prefer to make in response to perceived conflicts. Controllers preferred to use horizontal maneuvers (heading changes to left or right) rather than vertical or combination maneuvers (climbing or descending turns). Pilots on the other hand were equally likely to use horizontal, vertical, and combination maneuvers to resolve perceived conflicts.

Risk perception is a key component in decision making, especially in dynamic environments such as space and aviation. As systems grow in complexity and diversity of participants, those responsible for regulation, procedures, and operations must be aware of differences in risk perception between the various users. They also must be sensitive to differences in users' preferred strategies for resolving perceived conflicts. Results from this study will assist in developing new regulations and procedures for the evolving air traffic management system and guiding the design of new traffic displays and separation standards.

Point of Contact: Jeannie Davison  
(650) 604-1357  
jdavison@mail.arc.nasa.gov